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(54) Permanent wave neutralizer and conditioner composition

(57) A unitary storage-stable, high foaming multifunctional permanent wave neutralizer and conditioner composition contains an oxidizing agent useful in permanent waving, a surface active agent of the group consisting of zwitterionic surface active agents, amphoteric surface active agents or anionic surface active agents selected from the group consisting of alpha C<sub>14</sub>-C<sub>18</sub> olefin sulfonates, N-(C<sub>12</sub>-C<sub>18</sub>) fatty acyl sarcosines and alkali metal salts thereof and N-(C<sub>12</sub>-C<sub>18</sub>) fatty acyltaurines and alkali metal salts thereof, and a water-soluble cationic polymer containing a plurality of quaternary nitrogen atoms, and has a pH value of between about 2.5 to about 8.0. The composition is used in a method of altering the configuration of hair to neutralize chemically reduced hair and to provide conditioning and odor removal.

## SPECIFICATION

## Permanent wave neutralizer composition and method

5 *Technical field*

This invention relates to permanent waves for hair, and particularly to a neutralizer and conditioner composition for use in a permanent waving method.

*Background art*

10 One major consumer complaint about permanent waving treatments, particularly with thiol-based waving lotions, is that a residual post-permanent wave or "perm" odor lingers on the hair that is most noticeable when the hair is wet or moist.

This "perm" odor is due in part to residual chemicals from the waving lotion, such as the thiol reagent and ammonia, remaining in the hair that are not completely removed by water rinsing. Perm odor is also due to partially reduced hair, *i.e.*, where hair keratin-disulfide bonds are broken during the waving to form free-SH groups or mercaptan-containing degradation products, and are not completely formed into new disulfide-containing compounds during the neutralization step.

Attempts have been made to overcome this problem by using non-ammonia salts of water-soluble thiol reducing agents and by using water-soluble bisulfite ion-containing waving lotions. Although these waving lotions have no objectionable ammonia odor, they still produce a perm odor due to partially reduced hair.

Chemical neutralization is utilized by almost all practitioners of modern permanent waving because of its speed. Thus, there is a need for a neutralizer composition that can concurrently realign and reform hair disulfide bonds, and also assist in removing any residual chemicals remaining in the hair from the waving lotion.

Typically, the neutralizer is an oxidizing agent. Exemplary oxidizing agents include hydrogen peroxide or a compound containing hydrogen peroxide, such as sodium carbonate peroxide or urea peroxide, an alkali metal per-salt, such as sodium perborate, sodium persulfate, or potassium monopersulfate, and an alkali metal bromate salt, such as sodium bromate or potassium bromate.

30 Simple aqueous solutions of the aforementioned oxidizing agents can be used as a neutralizer in the form of a rinse that is poured over and through the hair. However, since these rinses are watery thin, they drip and do not uniformly contact all portions of the hair, resulting in unevenly neutralized hair. Further, these rinses are cumbersome to use and do not effectively remove perm odors from the hair, or provide conditioning benefits to the hair, such as static charge control and ease of detangling, *i.e.*, benefits commonly attributed to creme rinses.

Some attempts have been made to overcome this problem by including monomeric alkyl quaternary ammonium compounds, where the alkyl radical is derived from a  $C_{12}$ - $C_{18}$  fatty acid, typically used in creme rinse products. However, while the foregoing materials impart a conditioning benefit, they do not remove or mask perm odors. Further, the conditioning benefit is temporary and is easily removed by a subsequent washing with conventional detergent shampoo. Thus, there is an additional need for an effective neutralizer that concurrently imparts a lasting conditioned feel to the waved hair and can remove residual post-permanent wave odors from the hair.

It is known that to the extent that the reformation of the keratin-disulfide bond linkages that were originally broken in the waving process is less than complete, the wave pattern of freshly waved hair may lose its strength and stability in either air or water, or both. A discussion of this effect is found in Lichtin et al., in "A Permanent Wave Neutralizer: Its Performance and Mechanism of Action", (hereafter "Lichtin") *J. Soc. Cosm. Chem.*, 19, 849-862 (1968), incorporated herein by reference.

Lichtin teaches therein that thiol-waved hair that was followed by an oxidant-based neutralizer and was subsequently exposed either to water or to air, respectively, contracted and rearranged its curl patterns, or dropped and lost its curl strength. It is also known that the alkali solubility of hair increases when it is permanently waved and chemically damaged thereby.

Thus, while it is known that perm odors may be removed from waved hair by washing it immediately after waving with a conventional shampoo, this practice is not desirable. It is believed such a post-wave shampoo may break secondary, ionic salt or hydrogen bond linkages in freshly waved hair before the wave in the hair has sufficiently stabilized. This bond breakage is believed to hydrate and swell the hair resulting in an undesirable loss in wave strength. Thus, there is a need for a neutralizer having the high-foaming properties of a conventional shampoo capable of removing perm odor and residual chemicals from the waved hair without adversely affecting wave strength or removing conditioning benefits.

Lichtin also teaches that optimum wave stability is produced when primary disulfide linkages and secondary hydrogen bonds severed during the reductive wave are concomitantly relinked by the neutralizer, while the hair is in a strained state.

However, when the hair is longitudinally strained by being concentrically wrapped about a waving mandrel or curler, the neutralizer may not always penetrate therethrough to uniformly contact the proximal to distal portions of the wrapped hair switch, particularly where the distal portion of the hair is collected and anchored with end papers.

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Thus there is a need for an effective multifunctional neutralizer that uniformly contacts the proximal and distal portions of the partially reduced hair while it is still under strain, removes perm odor and imparts conditioning benefits.

Some attempts have been made to increase the efficiency of the neutralizer solution by including wetting agents to promote better penetration of the oxidizing solution through partially reduced, wrapped and strained hair. While some success has been achieved with cationic surface active conditioners, these materials are non-foaming and also suffer from the disadvantages previously discussed. Nonionic wetting agents are substantially non-foaming and provide no conditioning benefits. Conventional anionic wetting agents typically used in shampoo compositions are high foaming agents. However, these provide no conditioning benefits, may inactivate cationic conditioners, and may be unstable on long term shelf storage in the presence of oxidizing agents.

It is known that extreme care is necessary to manufacture and package a storage-stable unitary composition containing an oxidizing agent, such as hydrogen peroxide, or bromate salt to avoid explosive mixtures or loss of oxidizing strength.

A desirable multifunctional permanent wave neutralizer composition, therefore, would be a unitary storage-stable neutralizer and conditioner composition having 1) the benefits of a wetting agent in bringing all portions of the partially strained hair into uniform contact with the other components of the composition; 2) the benefits of a high-foaming shampoo in removing residual perm odors from the hair; 3) the benefits of the oxidizing agent in reforming the broken primary hair disulfide bond and secondary hydrogen bond and salt linkages in the hair; and 4) the benefits of a cationic conditioner in imparting a lasting conditioning effect on the hair.

#### *Summary of the invention*

According to one aspect of the present invention, a homogeneous, storage-stable, high-foaming permanent wave neutralizer and conditioner composition comprises water having dispersed therein an effective amount of an oxidizing agent useful in the neutralizing step of hair waving processes; an effective amount of a surface active agent of the group consisting of zwitterionic surface active agents, amphoteric surface active agents and anionic surface active agents, said anionic surface active agents selected from the group consisting of alpha C<sub>12</sub>-C<sub>18</sub> olefin sulfonates, N-fatty acyl sarcosine and alkali metal salts thereof, and N-fatty acyl taurines and alkali metal salts thereof, where the fatty acyl group is derived from C<sub>12</sub>-C<sub>18</sub> fatty acids; and an effective amount of a water-soluble cationic polymer, said polymer containing a plurality of quaternary nitrogen atoms, and having a molecular weight of from about 500 to about 10,000,000, said composition having a pH value of between about 2.5 to about 8.0, the composition capable of producing a high level of foam on contacting human hair during said neutralizing step and having a storage stability with regard to the oxidizing strength of the oxidizing agent of at least about 90 percent after being heated to a temperature of about 80 degrees C. (about 176 degrees F) for a period of about 24 hours.

The present invention thus relates to a unitary, multifunctional permanent wave neutralizer and conditioner composition useful in permanent waving processes and provides a composition which concurrently reforms hair keratin-disulfide bonds, imparts lasting conditioning benefits to the hair and removes residual post-wave perm odor from the hair.

Preferably, the amphoteric surface active agents are those which are capable of forming zwitterions (inner salts) at their iso-electric range.

It has been surprisingly found that a composition of this invention is storage-stable with regard to oxidizing strength of the oxidizing agent of at least 90 percent, preferably at least about 95 percent, after being heated to a temperature of about 80 degrees C. (about 176 degrees F.) for a period of about 24 hours. Further it is believed that it is possible to produce compositions in accordance with this invention which remain substantially homogeneous on storage at ambient room temperature conditions for a period of at least six months.

In one embodiment of this invention, a neutralizer and conditioner composition of this invention comprises water, about 0.5 to about 15 weight percent of oxidizing agent, about 0.1 to about 4 weight percent of zwitterionic surface active agent or amphoteric surface active agent, about 0.05 to about 5.0 weight percent of a water-soluble cationic polymer containing a plurality of quaternary nitrogen atoms, having a molecular weight of from about 500 to about 10,000,000, and a pH value of about 2.5 to about 8.0 obtained by the presence of an acid or an alkali metal hydroxide.

In a preferred embodiment the zwitterionic surface active agent is selected from the group consisting of agents having a betaine structure, a sultaine structure, an amphocarboxylate or amposulfonate structure, an iminodipropionate structure and an aminopropionate structure.

In another preferred embodiment, the water-soluble cationic polymer is a film-forming polymer. According to a second aspect of the present invention, a process for treating hair whose configuration is to be altered includes the steps of:

deforming the normal configuration of said hair by applying longitudinal strain to the hair, said strain physically altering the hair shape into a physically curled or straight configuration while said hair is at least partially damp;

contacting the hair while it is so strained with an effective amount of a reductive hair keratin disulfide-bond breaking agent selected from the group consisting of water-soluble thiol and bisulfite i n-containing reducing agents;

maintaining said contact for a period of from about 5 minutes to about 60 minutes sufficient for the reductive agent to break hair primary keratin disulfide bonds and form partially reduced strained hair keratin;

removing the keratin disulfide bond breaking agent from said partially reduced, strained hair by rinsing with water;

blotting the partially reduced, strained hair to a substantially damp state;

contacting the blotted hair while it is so partially reduced and strained by applying to said hair a first application of a neutralizer composition according to the first aspect of the present invention in an amount sufficient to substantially saturate and wet the hair;

maintaining said contact for a period of about 2 to about 45 minutes to sufficiently realign and reform said broken disulfide bonds into new keratin disulfide bonds to form treated hair;

removing said applied strain from said treated hair;

contacting said hair while it is free from applied strain by applying to said hair a second application of a composition according to the first aspect of the present invention in an amount sufficient to produce a high level of foam when said composition is lathered therethrough; and

maintaining said foam in contact with the treated hair for a period of about zero to about 5 minutes;

removing said neutralizer composition from the hair by rinsing said treated hair with water.

A composition and method of this invention possesses many advantages and benefits.

One advantage of the present invention is that the permanent wave method of this invention provides in a single step, the concurrent neutralization and conditioning of waved hair with a unitary neutralizer and conditioner composition.

Another advantage provided by this invention is that the hair treated with a neutralizer composition of this invention is conditioned, and this conditioning benefit lasts through multiple post-wave washings with conventional shampoos.

Still another advantage of the present invention is that a composition of this invention can be applied by contacting the partially reduced hair while it is in a strained state to promote uniform neutralization

therethrough. Additionally, a composition of this invention can be further applied to the neutralized hair, when it is free of the applied strain, and lathered therethrough to remove residual post-wave odors therefrom, and uniformly contact all portions of the hair with no adverse effect on wave strength.

A benefit of the invention is that a composition of this invention surprisingly produces a visibly discernible, high level of foam when the composition is lathered through the treated hair. Further, a composition of this invention surprisingly provides an unexpectedly high level of foam with a relatively low amount of surface active agent. An additional benefit is that a high level of foam is produced without using auxiliary aerating devices, such as sponges or gas-generating propellants.

Still another benefit of the invention is that a high-foaming composition of this invention provides a strong wave pattern when it is used as a neutralizer in a permanent waving process for curling the hair.

Still other benefits and advantages of the invention will be apparent to those skilled in the art from the disclosure which follows.

#### *Detailed description of the invention*

A neutralizer and conditioner composition of this invention is broadly useful as a multifunctional product in reductive permanent wave processes that chemically alter the natural configuration of human hair. The use of a unitary composition of this invention concurrently provides, in a single step of the overall waving process, waved hair that is uniformly neutralized to a strong wave pattern (configuration), is substantially free of objectionable post-permanent wave hair odors and has a lasting conditioned benefit. This multifunctional neutralizer composition thereby eliminates a multiplicity of steps now practiced to achieve similar results.

More particularly, a composition of this invention is a surprisingly homogeneous, storage-stable oxidant solution that contains an oxidizing agent suitable for use in the neutralizing step of hair waving processes and in hair dyeing arts, a relatively low level of a surface active agent that is zwitterionic or amphoteric surface active agent, or an anionic surface active agent of the group consisting of alpha C<sub>12</sub>-C<sub>18</sub> olefin sulfonates, N-fatty acyl sarcosine and alkali metal salts thereof, and N-fatty acyl taurines and alkali metal salts thereof, and a cationic polymer containing a plurality of quaternary nitrogen atoms as described hereinbelow at a pH value of about 2.5 to about 8.0.

As used herein, changing or altering the configuration of hair is meant to include reductive straightening and waving processes, both of which are performed while the hair is wet, or at least substantially damp, and under longitudinal strain. Waving processes that chemically alter the natural configuration of the hair include, but are not limited to, thiol permanent waving processes that are reductive of hair keratin-disulfide bonds.

Thiol waving agents are well known in the art and contain a free thiol (mercaptan, -SH group). Salts of thioglycolic acid, such as ammonium thioglycolate, and thioglycolic acid esters, such as glycerol thioglycolate, are typically utilized as the thiol waving agent. Other thiol-containing reagents such as ammonium

salts of thiolactic acid, beta-mercaptopropionic acid, beta-mercaptobutyric acid, mercaptosuccinic acid and the like are also known in the art to be effective.

The term "reductive", as used herein, also denotes waving by the cleavage of hair keratin-disulfide bonds by bisulfite ion-containing reagents. Such processes are sometimes referred to as "sulfite lysis".

5 The word "reductive" and grammatical variations thereof are meant herein to differentiate the waving procedures using reducing agents such as water-soluble thiol, and bisulfite salts from methods that are usually carried out with alkali hair treating compositions at high pH values, *e.g.*, at about pH 11 to about about pH 14. The alkali treating methods primarily transform the disulfide bonds of hair keratin cystine groups into lanthionine groups, whereas the reductive waving methods are believed to transform them into cysteine groups. Consequently, the reductive waving methods require oxidation of the hair in order to reform the broken hair keratin-disulfide bonds into realigned new bonds, whereas high alkali waving does not.

10 In preferred practice, about 15 to about 75 percent of the hair disulfide bonds are broken during the contact of reductive waving lotion on the hair. It is well known that not all of the broken disulfide bonds are reformed into new disulfide bonds during the oxidative neutralizing step of the hair waving process. It is to be understood, however, that hair treated with a neutralizer of this invention is believed to reform about 85 to 95 percent of the broken cystine bonds.

15 It is further to be understood that the term "partially reduced" hair as used herein denotes hair that contains broken primary keratin-disulfide bonds as well as broken secondary hydrogen bonds and salt linkages.

20 The term "permanent wave" and grammatical variations thereof as used herein includes the process of reductively imparting a curled configuration to naturally straight hair and to the process of reductively straightening curly hair, since the chemistry involved and the problems of residual hair perm odors associated therewith are substantially similar. It is to be understood that the term "permanent waving" as used hereinafter denotes a reductive process.

25 The terms "post-wave odor" and "perm odor" are used interchangeably herein to denote the objectionable odor of residual chemicals remaining on the hair, such as thiol and ammonia odors, and to the odor of partially reduced hair containing free -SH groups therein.

Permanent waving in its simplest aspect normally consists of the following five basic steps:

30 1) deforming the normal configuration of the hair by longitudinally straining the hair and altering it into a physically curled or straightened configuration while the hair is wet or at least partially damp with water or waving lotion. (The terms "straining" or "strained" with reference to hair as used herein denote hair that has been either concentrically wrapped about itself or about a curling mandrel or roller, or has been weighted with a viscous waving product or drawn by combing;

35 2) contacting the hair, while it is so strained with an aqueous waving lotion that contains ammonia and an effective amount of a hair keratin disulfide bond breaking agent selected from the group consisting of water-soluble thiol and bisulfite ion-containing reducing agents well known in the art;

40 3) maintaining that contact for a time period sufficient for the disulfide bond-breaking agent to reductively break primary hair disulfide bonds to form partially reduced hair that is swollen and softened; (it being believed that any free alkali, if present, in the waving lotion also breaks secondary ionic salt and hydrogen bonds during this period);

4) realigning the broken hair keratin disulfide bonds into new spatial configurations to form partially reduced hair having an altered configuration;

45 5) reforming the broken hair keratin disulfide bonds (and presumably secondary bonds) while the hair is so strained, by saturating and wetting it with a neutralizer composition that contains an amount of oxidizing agent effective to form new hair keratin disulfide bonds and to maintain the new hair configuration.

In typical practice, the reducing agent and the neutralizer are rinsed from the hair after step 3 and step 5, respectively.

50 It has been found that the use of a neutralizer composition of this invention in step 5 beneficially improves the permanent wave achieved as described hereinbelow.

It is well known that realigning and reforming of new keratin-disulfide bonds from the broken disulfide bonds via oxidation in step 5 is critical and necessary in thiol-based permanent wave processes. The neutralizer for a thiol-based reagent having a free -SH group, such as thioglycolic acid, ammonium thioglycolate, glyceryl thioglycolate and the like, normally contains an oxidizing agent.

55 In sulfitolysis, alkaline neutralizers are sometimes used to raise the pH value of the liquid in contact with the hair to form the new hair-disulfide bonds. However, oxidative neutralizers can be used to complete the neutralization process and assist in destroying undesirable, residual sulfite byproducts.

60 Researchers have reported that strain on the hair can increase the rates of both the oxidation and reduction of hair. Additionally, the degree to which conventional oxidant-containing neutralizers are capable of reforming all the secondary bonds that are severed during the waving process, however, is not fully known. The complex kinetics of permanent wave processes have been extensively reported in the literature readily available to the practitioner of waving arts.

65 The composition of hair waving and hair straightening compositions useful herein may contain from 1.0 to about 30 weight percent of water-soluble thiol or bisulfite ion-containing reducing agents. Thiol-

based compositions preferably contain about 2 to 20 weight percent ammonium or alkanolamine thioglycolate in a lotion having a pH value of about 7.5 to about 9.5, or about 3 to about 30 weight percent of glyceryl thioglycolate in a lotion having a pH value of about 6.5 to about 8.5. Bisulfite ion-containing compositions preferably contain about 8 to about 15 weight percent ammonium or sodium bisulfite present in a lotion having a pH value of about 6 to about 10.

Oxidizing agents that are useful in neutralizer compositions herein are well known in the art as previously described. In preferred practice, oxidizing agents for permanent waving are selected from the group consisting of hydrogen peroxide, alkali metal bromate salts and alkali metal iodate salts, but are not so limited. Particularly preferred oxidizing agents are hydrogen peroxide, sodium bromate, potassium bromate, sodium iodate and the like. Hydrogen peroxide is a particularly preferred oxidizing agent. It should be understood that the choice of oxidizing agent is limited only by its storage stability in solution as measured herein with regard to oxidizing strength.

The oxidizing agent is present in the neutralizer in an amount effective to reform about 90 to 95 percent of the original reductively broken disulfide bonds into newly realigned disulfide bonds to maintain the altered configuration of the waved hair. The extent of efficient reformation may be determined by various techniques reported in the literature, such as amino acid analyses for cystine and cysteine content, by measuring retention of coil set in water, or by measuring the work necessary to stretch waved fibers a given length under load to determine their toughness or "work index".

Oxidizing agents may be present in an amount of about 0.5 to about 15 weight percent of the composition. Preferably the oxidant is present in an amount of about 0.5 to about 12 weight percent, and more preferably in an amount of about 1 to about 10 weight percent.

Those skilled in the art will appreciate that the effective amount of oxidizing agent may vary with the choice of oxidizing agent and waving process utilized, and is readily selected by one skilled in the art.

In preferred waving practice, hydrogen peroxide may be present in an amount of about 0.5 to about 4.0 weight percent, preferably in an amount of about 1.0 to about 3.0 weight percent; A composition containing hydrogen peroxide preferably has a pH value in the range of about 2.5 to about 5, preferably of about 2.5 to about 4.5, more preferably of about 3 to about 4.

In neutralizer compositions utilizing bromate salts, sodium bromate or potassium bromate may be present in an amount of about 5 to about 15 weight percent, preferably in an amount of about 8 to about 12 weight percent. The bromate-containing neutralizer compositions preferably have a pH value in the range of about 4 to about 8.0, and more preferably of about 4.5 to about 7. Aqueous solutions of these bromate salts typically themselves provide a pH value of about 7 to about 9. Where a more acidic or more basic pH value is desired in a bromate neutralizer, a sufficient amount of acid or base, respectively, is included as needed.

Those skilled in the art will appreciate that the desired pH value of a neutralizer of this invention is obtained by the presence of a sufficient amount of either acid or non-volatile base included to adjust the pH value of the medium. Suitable organic acids known in the art are selected from the group consisting of acetic, adipic, citric and tartaric acids. Of these acids, citric and tartaric are preferred. Suitable inorganic mineral acids are boric, hydrochloric, sulfuric and phosphoric, with phosphoric acid being particularly preferred. Suitable bases are nonvolatile alkali metal hydroxides, such as potassium hydroxide and sodium hydroxide, with sodium hydroxide being particularly preferred.

It has been surprisingly found that zwitterionic surface active agents and amphoteric surface active agents are particularly useful in this invention. A zwitterionic or amphoteric surface active agent, as used herein, is a surface active agent that contains both anionic and cationic moieties in the same molecule.

Certain amphoteric surface active agents can become zwitterions within their iso-electric range. The iso-electric range is that pH value at which the positive cationic charges balance the negative anionic charges of the surfactant to form an inner salt or zwitterion. It is to be understood that the term "term active agent" and "surfactant" may be used interchangeably. It is to be further understood that the term "zwitterionic" as used hereinafter includes the foregoing amphoteric surface active agents.

A discussion of zwitterionic and amphoteric surface active agents is found in Milwidsky, "Non-Conventional Surface Active Agents," HAPPI (Reprint), 1981, the disclosures of which are incorporated herein by reference (hereinafter "Milwidsky").

An effective amount of zwitterionic surface active agent may be present in an amount of about 0.1 to about 4 weight percent of the composition. Preferably, however, the zwitterionic surfactant is present in a relatively low amount of about 0.2 to about 2 weight percent.

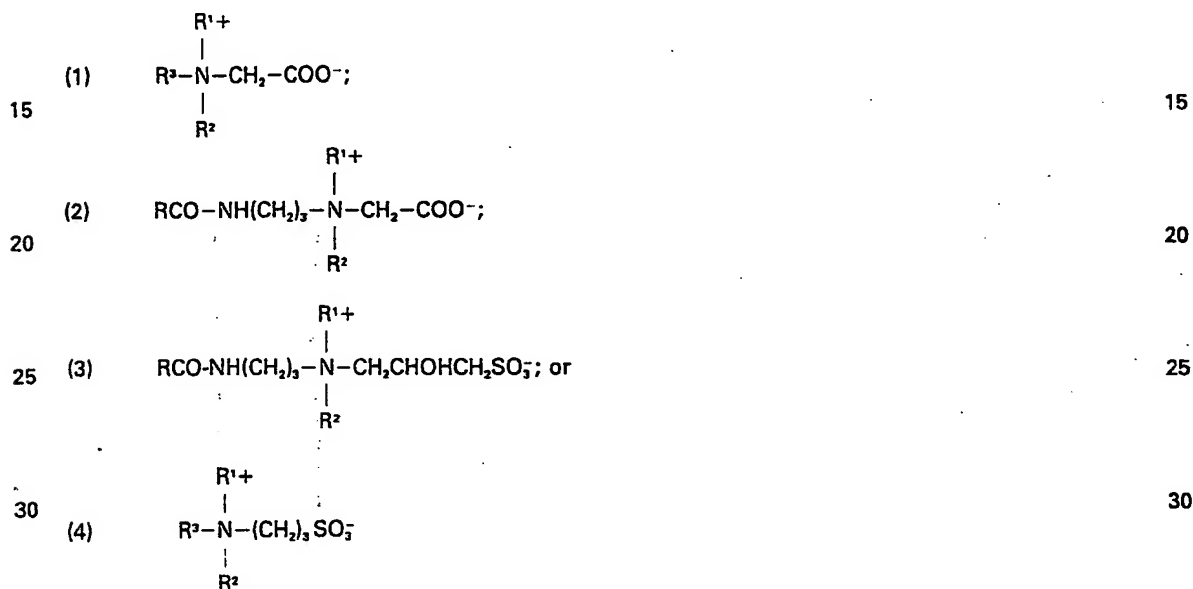
It was surprisingly found that compositions of this invention containing the above relatively low levels of zwitterionic surface active agents, *e.g.*, less than 1 weight percent, produced a high level of foam. The term "high level of foam" as used herein describes an abundant volume of creamy foam when the composition is lathered through wet or substantially damp hair during the neutralization step. The volume of foam and its creamy feel observed is usually attributed to that produced by a conventional anionic shampoo that contains a relatively high amount of about 10 to about 15 weight percent of a surface active agent, such as ammonium lauryl sulfate.

This was surprising since Milwidsky teaches that at the iso-electric point of zwitterionics their water solubility and detergency function, *i.e.*, wetting, foaming, surface tension or detergency itself, is at a minimum. Thus, one would expect low foam levels, as well as some precipitation or insolubility problems

requiring the addition of solubilizing agents. However, compositions of this invention containing zwitterionic surface agents were surprisingly found to be substantially homogeneous in storage at ambient room temperature for a period of at least six months without requiring any solubilizing agents.

The mechanism by which the observed high foaming levels is produced with relatively low amounts of zwitterionic surface active agents of the present invention is not fully understood. While not wishing to be bound by any theory, it is believed that a peroxide-rich foam mixture or complex of oxidizing agent and surface active agent may form during the neutralizing step, which in turn enhances the foaming.

Zwitterionic and amphoteric surface active agents that are particularly useful for a high foaming neutralizer composition of this invention, may be agents having a betaine or sultaine structure corresponding to a general formula selected from the group consisting of:



where  $\text{R}^1$  and  $\text{R}^2$  are the same or different and are selected from the group consisting of an alkyl radical having about 1 to 4 carbon atoms and a hydroxyalkyl radical having about 2 to 3 carbon atoms and, preferably, both being methyl groups;

$\text{R}^3$  is an alkyl radical having about 8 to 18 carbon atoms; and

$\text{R}$  is an alkyl radical having about 7 to 17 carbon atoms;  $\text{R}$  and its bonded carbonyl group ( $\text{RCO}-$ ) is preferably derived from a  $\text{C}_{12}-\text{C}_{18}$  fatty acid. Preferred  $\text{C}_{12}-\text{C}_{18}$  fatty acids are lauric acid, myristic acid, stearic acid, tallow acids or coconut fatty acids.

Example betainic agent of formula (1) are alkylbetaines where the alkyl group is derived from coconut fatty acids or tallow acids. Suitable alkylbetaines are given the respective means of Coco-betaine and Dihydroxyethyl tallow glycinate in the *CTFA Cosmetic Ingredient Dictionary* (hereinafter "*CTFA Dictionary*"), 3rd ed., 1982, published by the Cosmetic, Toiletry and Fragrance Association and in the *Cosmetic Bench Reference encyclopaedia of cosmetic materials* (hereinafter "*Bench Reference*"), Cosmetics & Toiletries, 1984 edition, August 1984, and its addenda, December, 1984 the disclosures of which are incorporated herein by reference.

Persons skilled in the art will appreciate that suitable suppliers of the foregoing alkyl-betaines and other ingredients described hereinafter are extensively listed in the aforementioned references. Particularly preferred alkylbetaines are the coco-betaines available under the trademark designations LONZAINE 12C from Lonza, Inc., Fairlawn, N.J. and SCHERCOTAIN CB from Scher Chemicals, Inc., Clifton, N.J. (hereinafter "*Scher*").

An example of a betainic agent of formula (2) is an alkylamidobetaine where the alkyl radical and its bonded carbonyl group ( $\text{RCO}-$ ) are preferably derived from a fatty acid, such as lauric acid, myristic acid, stearic acid, tallow acids or coconut fatty acids. Suitable alkylamidobetaines are given the respective names lauramidopropyl betaine, myristamidopropyl betaine, stearamidopropyl betaine and cocamidopropyl betaine in the *CTFA Dictionary*. Particularly preferred alkylamidobetaines are available under the trademark designations SCHERCOTAIN LAB, MAB, and CB supplied by Scher.

An example of a sultaine of formula (3) is one in which the alkyl radical  $\text{R}$  and its bonded carbonyl group ( $\text{RCO}-$ ) are preferably derived from a fatty acid such as lauric acid, stearic acid, tallow acids, coconut fatty acids and the like. A particularly preferred sultaine is an alkylamidopropylhydroxy-propylsulfobetaine where the alkyl radical  $\text{R}$  contains about 7 to about 17 carbon atoms, and where  $\text{R}$  and its bonded carbonyl group ( $\text{RCO}-$ ) are preferably derived from coconut fatty acids. An illustrative sultaine is given the name cocamidopropylhydroxysultaine in the *CTFA Dictionary* and in the *Bench Reference*.



Particularly preferred sultaines are available under the trademark VARION® CAS from Schering Chemical Company, Inc., subsidiary of Schering A.G., Dublin, OH, and MIRATAINE CB5 from the Miranol Chemical Company, Inc., Irvington, N.J.

An example of a sultaine agent of formula (4) is an alkylsultaine in which the quaternized nitrogen atom is bonded directly to a carbon atom of an alkyl moiety preferably derived from coconut fatty acids. A suitable alkylsultaine is given the name cocosultaine in the *CTFA Dictionary* and in the *Bench Reference*.

An additionally useful surface active agent is an amphoteric surfactant capable of forming a zwitterion (inner salt) within its iso-electric range. Illustrative materials include surface active agents having

(a) an amphocarboxylate or amphosulfonate structure found under the name cocoamphocarboxypropionate, cocoamphocarboxypropionic acid, cocoamphocarboxypropylsulfonate, cocoamphoglycinate, cocoamphopropionate, cocamphocarboxyglycinate, and cocoamphopropylsulfonate in the *CTFA Dictionary* and *Bench Reference*, said by their supplier to contain cationic and anionic groups of equal strength and monocarboxy and di-carboxy groups derived from C<sub>10</sub>-C<sub>18</sub> fatty acids;

(b) an iminodipropionate structure, such as N-fatty alkyl beta-iminodipropionic acid and alkali metal partial salts thereof, where the fatty alkyl group is derived from C<sub>12</sub>-C<sub>18</sub> fatty acids. Illustrative materials include disodium-N-tallow-beta-aminodipropionate, disodium-N-lauryl-beta-aminodipropionate and the material given the name sodium lauriminodipropionate in the *CTFA Dictionary*; and

(c) an aminopropionate structure, such as N-fatty alkyl beta-aminopropionic acid and alkali metal salts thereof, where the fatty alkyl group is derived from C<sub>12</sub>-C<sub>18</sub> fatty acids. Illustrative materials include N-coco-beta-aminopropionic acid, sodium-N-coco-beta-aminopropionate, and the material given the name lauraminopropionic acid, in the *CTFA Dictionary* and sodium laurylaminopropionate in the *Bench Reference*.

One criterion for selecting a surface active agent for a neutralizer of this invention is that the surface active agent be stable on long term storage in the presence of an oxidizing agent, and another is that it not inhibit the conditioning effect of the polymeric conditioner.

Conventional linear sulfated alcohol anionic surface active agents, such as sodium lauryl sulfate, have been used as wetting agents in neutralizer compositions. The commonly known, high-foaming anionic surface active agents are usually ammonium, primary, secondary, or tertiary amine, and alkali metal salts of fatty alkyl sulfates, or alkyl ether sulfates where the fatty alkyl group contains about 12 to 14 carbon atoms derived from fatty alcohols, and the ether linkage is comprised of about 1 to about 4 ethoxy units.

However, these materials suffer from the disadvantage of hydrolyzing and decomposing, especially under the acidic pH conditions in the range of about 3 to 4 preferred for hydrogen peroxide compositions. While this hydrolysis may or may not result in a loss of the oxidizing strength of hydrogen peroxide, the hydrolyzed material liberates sulfuric acid. This, in turn, may lower the pH value of the composition sufficiently to irritate the skin of the user. Further, sufficient surfactant hydrolysis and decomposition may result in loss of foaming.

In a neutralizer composition containing bromate as the oxidant, an increase in the acidity of the medium is particularly undesirable as it may result in the liberation of bromine.

Similarly, anionic surface active agents that contain ester linkages, such as sodium lauroyl isethionate and disodium lauryl sulfosuccinate, also hydrolyze in a pH range of about 3 to 4. Additionally, these and the previously discussed anionic surface active agents tend to interact with cationic ingredients and form insoluble precipitates therewith, and do not themselves provide any conditioning benefits. Thus, the foregoing conventional anionic surface active agents do not satisfy the criteria for a surface active agent for use in a neutralizer of this invention described hereinbefore.

Another disadvantage of the above discussed conventional anionic surface active agents is their strongly detergent character, which is believed to extract more than just the residual permanent wave chemicals from partially reduced hair.

We have found that certain non-conventional anionic surfactants that are free of hydrolyzable moieties and are compatible with cationic ingredients are suitable as surface active agents for a storage-stable neutralizer composition of this invention. The term "non-conventional" and "conventional" in regard to anionic surface active agents is used herein to distinguish between specialty, uncommon non-hydrolyzable synthetic detergents as found in *Milwidsky* and those in common commercial cosmetic use.

One exemplary, non-hydrolyzable anionic surface active agent is an alpha-olefin sulfonate having about 14 to 16 carbon atoms in the olefin chain in which the double bond is sulfonated. An illustrative material is given the name sodium C14-C16 olefin sulfonate in the *CTFA Dictionary* and in the *Bench Reference*. A particularly preferred material is supplied under the trademark BIO TERGE AS-40 by the Stepan Company, Northfield, IL.

Other non-hydrolyzable anionic surface active agents that satisfy the criteria of a storage-stable surface active agent suitable for a neutralizer of this invention include N-fatty acyl sarcosine and salts thereof (sarcosinates) and N-fatty acyl taurine and salts thereof (taurates), each having its fatty acyl portions (fatty alkyl radical and its bonded carbonyl group) derived from a C<sub>12</sub>-C<sub>18</sub> fatty acid. Preferred materials are found in the *CTFA Dictionary* under the names lauroyl sarcosine, myristoyl sarcosine, cocoyl sarcosine, sodium lauroyl sarcosinate, sodium myristoyl sarcosinate, sodium methyl cocoyl taurate and sodium methyl oleyl taurate.



Nonionic surface active agents are substantially non-foaming materials, and are thus not suitable for the foaming function of a surface active agent of this invention. Additionally, nonionic surface active agents provide no conditioning benefits of their own. Further conventional nonionic surface active agents that are typically used to boost foam, such as alkanolamides, hydrolyze on long-term storage at about pH 4 or below. Thus, such materials are unsuitable for use in neutralizers containing hydrogen peroxide.

Hydrogen peroxide is said to be storage stable in solutions containing certain nonionic surface active agents, such as mixtures of  $C_{12}$ - $C_{18}$  fatty esters of sorbitol or sorbitol anhydrides that are condensed with about 4 to about 20 moles ethylene oxide,  $C_{12}$ - $C_{18}$  fatty monoesters of hexitol anhydrides derived from sorbitol, polyethylene glycol esters of  $C_{12}$ - $C_{18}$  fatty acids containing an average number of ethoxy groups of about 8 to about 50, polyethylene glycol ethers of  $C_{12}$ - $C_{18}$  containing an average number of ethoxy groups of about 4 to about 20, and the like. Illustrative materials are supplied by ICI Americas, Inc. under the trademarks TWEEN®, ARLACEL®, MYRJ® and BRIJ®. While these materials are not suitable for the foaming function of this invention, they may be included as auxiliary foam stabilizers to the extent that they do not interfere with the conditioning benefits of this invention.

Cationic surface active agents are substantially non-foaming materials and, thus, are not suitable for the high-foaming function of a surface active agent in a composition of this invention.

In a preferred embodiment of this invention, a long-lasting conditioning benefit is imparted to the hair during the neutralization process. For the multifunctional purposes of a neutralizer of this invention, the conditioner should provide a conditioning benefit that is not easily removed by a subsequent washing with conventional shampoo. Additionally, it should neither form a precipitate with the surface active agent, nor should it suppress the foam level thereof.

Cationic monomeric quaternary ammonium compounds are known in the art as conditioning agents, and some have been used in aqueous neutralizer compositions as discussed hereinbefore. However, these materials provide temporary conditioning benefits that are substantially removed by a subsequent washing with conventional shampoos.

Further, it has been found that certain monomeric quaternary ammonium compounds either suppress the foaming level produced by a useful zwitterionic surface active agent herein, or form precipitates with them in neutralizer compositions containing hydrogen peroxide on storage at ambient room temperature within 24 hours.

For example, a known cationic conditioning agent, given the name dicetyldimonium chloride in the *CTFA Dictionary* and in the *Bench Reference*, suppressed the foaming of a preferred cocamidopropylbetaine in the compositions containing hydrogen peroxide or sodium bromate. On the other hand, another known cationic conditioning agent, given the name cetrimonium chloride in the *CTFA Dictionary* and in the *Bench Reference*, did not suppress the foaming of the surface active agent in compositions containing hydrogen peroxide, but formed a precipitate therein on storage at ambient room temperature within 24 hours.

The preferred conditioning agents for the purpose of this invention, therefore, are water-soluble cationic polymers that contain a plurality of quaternary nitrogen atoms. The useful polymers are "cationic" in that they bear a plurality of net positive ionic charge in aqueous solutions. In a particularly preferred embodiment, the cationic polymers are film-forming polymers having a plurality of quaternary nitrogen atoms, preferably bearing at least two methyl substituents.

The term "film-forming" is meant to indicate that the polymers provide a film when a polymer-containing aqueous solution or dispersion is spread over a substrate and allowed to dry. Quaternary nitrogen atoms of these polymers are each covalently bonded to four carbon atoms and are therefore cationic; i.e., positively charged in water, since the usual valence for nitrogen is three.

A wide variety of water-soluble cationic polymers containing a plurality of nitrogen atoms are useful herein. Broadly, such polymers are useful in the range of about 0.05 to about 5 weight percent of the compositions. Preferably, these polymers are present in the range of about 0.2 to about 2 weight percent, and more preferably these polymers are useful in the range of about 0.2 to about 1 weight percent. The molecular weights of the polymers useful herein are broadly between about 500 and about 10,000,000, and preferably between about 100,000 and about 4,000,000 with various useful polymers having a generally more narrow molecular weight range.

Illustrative cationic, film-forming polymers include, but are not limited thereto:

(a) the materials sold under the trademarks POLYMER JR-30M, JR-125 and JR-400 by Union Carbide Corp., Danbury, CT, that are designated in the *CTFA Dictionary* and *Bench Reference* as Polyquaternium-10, described as a polymeric quaternary ammonium salt reaction product of hydroxyethyl cellulose reacted with a trimethylammonium-substituted epoxide, and is disclosed and claimed in U.S. Patent no. 3,472,840, whose disclosures are incorporated herein by reference;

(b) the material sold under the trademarks CELQUAT H60, H100 and L200 by National Starch and Chemical Corp., Bridgewater, NJ. CELQUAT H60 and L200 are designated in the *CTFA Dictionary* and *Bench Reference* as Polyquaternium-4, and described as copolymers of hydroxyethyl cellulose and diallyldimethylammonium chloride, the supplier's literature indicating that the cationic polymer is grafted onto the cellulosic backbone;

(c) and (d) the materials sold under the trademarks MERQUAT-100 and -550 (and a material very similar in description to MERQUAT-550 designated MERQUAT-S) by the Merck Chemical Division of Merck &

Co., Inc., Rahway, NJ, that are designated as Polyquat mium-6 and -7 in the *CTFA Dictionary* and *Bench Reference*, and are described as a homopolymer of diallyldimethylammonium chloride and a copolymer reaction product of diallyldimethylammonium chloride and acrylamide monomers, respectively;

5 (e) the materials sold under the trademark GAFQUAT-734 and -755 by GAF Corp., Wayne, NJ, that are designated as Polyquaternium-11 in the *CTFA Dictionary* and *Bench Reference*, and are described as quaternary ammonium polymer reaction products of dimethyl sulfate and a copolymer of vinyl pyrrolidone and dimethylaminoethyl methacrylate;

10 (f) the material sold under the trademark BINA QAT P-100 by Ciba-Geigy Corporation Dyestuff & Chemicals Division, of Greensboro, NC, that is described as having the *CTFA* adopted name Polyquaternium-15, and of being a copolymer of acrylamide and methacryloyl-oxyethyl trimethylammonium chloride having a degree of quaternization of 2.2 millimoles per gram of polymer; and

15 (g) the material sold under the trademarks LUVIQUAT FC-905, -550 and -37 by BASF Aktiengesellschaft, Ludwigshafen, FRD (also available from Arma Industrial Chemicals Division, Philadelphia, PA), that are described as being copolymers of methylvinylimidazolium chloride and vinyl pyrrolidone, the copolymers being prepared from the monomers in weight ratios of 95:5, 50:50 and 30:70, respectively.

20 Of the foregoing polymers, the average molecular weights are reported to be between about 300,000 and about 1,000,000 for the POLYMER JR series with polymers of a given designation having narrower average molecular weights. Of these, POLYMER JR-400 is said to be between a molecular weight of about 300,000 and about 400,000, nearer to 400,000 than to 300,000, and above that of POLYMER JR-125, which is reported to have an average molecular weight between about 300,000 and about 400,000, and nearer to 300,000 than to 400,000. POLYMER JR 30M is reported to have an average molecular weight between about 700,000 and 1,000,000.

25 The CELQUAT polymers are reported to have an average molecular weight of from about 200,000 to about 500,000. The polymers designated MERQUAT-100, -500, and -S, respectively, are reported to have an average molecular weight of about 100,000 to about 1m,000,000, of about 1,000,000 to about 10,000,000, and of about 2,000,000.

30 The polymer designated GAFQUAT-734, is reported to have an average molecular weight of less than about 100,000, while that designated GAFQUAT-755 is reported to have a molecular weight of greater than 1,000,000.

35 It is to be understood that the usefulness of a cationic polymer containing a plurality of quaternary nitrogen atoms, is limited herein only to the extent that they may contain moieties that are subject to oxidation during long term shelf storage.

Oxidizing agent stabilizers may be also added to neutralizer compositions of this invention to prevent the decomposition of the oxidizing agent. Illustrative stabilizers are sodium hexametaphosphate, acetanilide, phenacetin methylparaben, urea, and sodium stannate. Further, heavy metal chelating agents may be included, especially iron chelating agents.

40 The neutralizer compositions of this invention may also contain additional cosmetic adjuvant ingredients, such as preservatives, opacifiers, perfumes, thickeners, and auxiliary foam boosting agents selected for their commonly known cosmetic purposes.

45 The high level of foam produced with the zwitterionic surface agent as the sole wetting agent in the neutralizer was an abundant amount of dense creamy foam. The volume of foam was subjectively evaluated during the lathering step of the neutralizing process by experienced professional beauticians under salon use. Under laboratory conditions, the level of foam was evaluated by a predictive method based on the height of a column of foam observed in a graduated cylinder, when a dilute solution of the neutralizer contained therein was shaken. This method is described in Example 1 hereinbelow.

50 The foam observed was not suppressed by the presence of a water-soluble, high molecular weight, cationic, film-forming polymer containing a plurality of quaternary nitrogen atoms as described hereinbefore. This result is believed consistent with the work of Goddard, et al. reported in "Water-Soluble Polymer-Surfactant Interaction - Part 1," *J. Soc. Chem.*, 26, 461-475 (1975), incorporated herein by reference, wherein a cationic substituted cellulose ether (Polymer JR) did not lower the surface tension of an alkyl betaine or give any evidence of interaction therewith.

Further, the zwitterionic surface active agent did not interfere with either the oxidizing action of the oxidizing agent or the conditioning effectiveness of the cationic polymer.

55 Additionally, the compositions of this invention remained substantially homogeneous for a period of at least six months' storage at ambient room temperature conditions. Moreover, the homogeneous, high foaming neutralizer compositions were storage stable with regard to the oxidizing strength of the oxidizing agent.

60 Under conditions of accelerated ageing, compositions of this invention maintained an average of at least about 90 percent, usually at least about 95 percent, of available oxidizing agent. Accelerated ageing conditions comprised storing a bottled neutralizer composition at an elevated temperature by immersing it in a water bath at a constant temperature of about 80 degrees C (about 176 degrees F) for a period of about 24 hours.

65 The oxidizing strength was determined before and after heating by analytical titrimetric methods well-known in the art, and the strength of the remaining oxidizing agent was calculated therefrom. Procedures for the analytical methods are found in chapter 11 of *Newburger's Manual of Cosmetic Analysis*, Second

edition, edited by Zenzel (1977) and in the *Official Methods of Analysis*, 12th edition (1975), both published by the Association of Official Analytical Chemists, (AOAC), Washington, D.C. The results of this accelerated ageing technique is predictive of long-term shelf storage stability.

An illustration of the use of the neutralizer and conditioner composition in a waving method of this invention on hair whose configuration is to be altered is as follows. The hair is usually first shampooed and left wet or at least substantially damp. The normal configuration of the hair is defined by applying longitudinal strain to the hair and physically altering the hair shape into a curled configuration, by concentrically wrapping the hair about itself or about a curling mandrel or roller, or into a straight configuration, by weighting the hair with a viscous waving product and/or having the hair drawn by combing.

While the hair is so strained, it is contacted with a permanent wave lotion containing an effective amount of a hair keratin disulfide-bond breaking agent selected from well known water soluble thiol or bisulfite ion-containing reducing agents discussed previously. The manner of so contacting the hair is well known to those skilled in the art.

The contact with the reducing agent is maintained for a period of time sufficient to break about 15 to about 75 percent of hair keratin disulfide bonds and to form partially reduced hair keratin. A preferred period is from about 5 minutes to about 60 minutes.

The keratin-disulfide-bond breaking agent is removed from the partially reduced, strained hair by rinsing it with water, and the partially reduced, strained hair is blotted to a substantially damp state with a cloth or paper towel.

After a period of from about zero to about 60 minutes of the blotting step, the blotted hair is treated, while it is still partially reduced and strained by contacting it with a first application a neutralizer composition of this invention. A sufficient amount of neutralizer to substantially saturate and wet the hair is applied to the hair and this contact between hair and neutralizer is maintained for a period sufficient to reform about 85-95 percent of the keratin-disulfide originally broken into new re-aligned keratin-disulfide bonds. A preferred period of time for maintaining the contact is from about 2 minutes to about 45 minutes, preferably from about 2 minutes to about 10 minutes from the saturation point.

The longitudinally applied strain is then removed from the treated hair. While the treated hair is free from applied strain, it is contacted with a second application of the neutralizer composition in an amount sufficient to produce a high level of foam when the composition is lathered therethrough. The term "lathered therethrough" means that the composition produces foam when it is worked through the hair in a shampooing-like lathering motion free of auxiliary aerating devices, such as bottles or sponges, or gas-generating ingredients, such as aerosol foam propellants.

The neutralizer composition is lathered through the treated hair in a shampooing-like manner for a period sufficient to produce foam and the foam is maintained in contact with the hair for a period sufficient to remove residual post-permanent wave chemicals and odor from the hair. A sufficient period is from about zero to about 5 minutes. The neutralizer composition is removed from the hair by rinsing with water in the usual manner.

Optionally, a third application of neutralizer composition may be applied and lathered therethrough and rinsed. Additionally, the neutralizer may be optionally lathered through the hair again at a later date if so desired. Persons skilled in the art will appreciate that certain persons having abundant, thick hair or very porous hair may retain perm odors that are difficult to remove therefrom.

Permanently waved hair that is so treated in the foregoing manner with a neutralizer and conditioner composition of this invention, is effectively either curled with a strong wave pattern or visibly straightened, as desired, and is substantially free of residual post-permanent wave odor. Further, the treated hair is conditioned and this effect lasts through multiple subsequent washings with conventional highly detergent shampoo.

In a permanent wave treatment where a curl is desired, the tightness of the curl pattern was surprisingly enhanced by a neutralizer composition of this invention over that obtained with the oxidizing agent alone. It is believed that the surface active agent, in the presence of a cationic polymer useful herein, uniformly neutralizes all portions of the hair being waved 1) by either improving the wetting, or the contact, of the hair shafts by the neutralizer composition or 2) by some mechanism that potentiates oxidation of partially reduced hair that is not fully understood.

Researchers have reported electrokinetic measurements that show that the cationic polymers sold under the trademark series POLYMER JR, influence the electrical properties of hair and skin keratin in terms of its pH profile or point of zero charge (zeta potential) in the presence of various surface active agents. A discussion of these effects is found in Goddard, et al., "Electrical Properties of Skin and Hair", Preprints Vol. 1. 79-95, of lectures presented October 16, 1984 at the XIII Congress of the International Federation of Societies (I.F.S.C.C.) of Cosmetic chemists in Buenos Aires, Argentina.

It is believed that these electrokinetic changes in or on the surface of the hair may potentiate the neutralizer's effectiveness in concurrently reforming hair disulfide bonds and conditioning same. The above cationic polymers have been reported to potentiate the efficiency of ultraviolet light absorbers commonly known as sunscreens. (Liang et al., "Potentiation of Sunscreens", Union Carbide Bulletin F-48385, 1982 Reprint of a lecture presented September 14, 1982 at the 12th Congress of the International Federation of Societies of Cosmetic Chemists. Paris. France). However, there is little structural or chemical similarity between the sunscreens described, all of which are aromatic benzenoid compounds, and the materials

present in the compositions of the present invention. It would consequently appear that any potentiation occurring here would be different from that reported by Liung et al.

The foregoing is intended as illustrative of the present invention but not limiting. Numerous variations and modifications can be made without departing from the true spirit and scope of the invention.

5 The invention is further illustrated by the examples which follow.

#### EXAMPLES

##### *Example 1. Neutralizer and Conditioner Composition.*

This Example illustrates a neutralizer and conditioner compositions of this invention containing a relatively low level of a zwitterionic surface active agent, a water-soluble cationic polymer containing a plurality of quaternary nitrogen, and an oxidizing agent.

The compositions of this Example were prepared by dispersing the ingredients No. 2 to 4 into ingredient No. 1 in the order shown in the following table, and then adjusting the pH value with the ingredient no. 5. For purposes of illustrating the invention, the active weight percent of Ingredient No.2 and of ingredient No. 3 were present in equal amounts, but useful amounts of those ingredients are not intended to be so limited.

		Weight percent active				
	Ingredient Formula:	A	B	C	D	
20	1. Water, deionized to 100%	q.s.	q.s.	q.s.	q.s.	
	2. Cocamidopropyl betaine (Note a)	0.6	0.6	0.6	0.6	25
25	3. Polyquaternium 6 (Note b)	0.6	0.6	-	-	
	Polyquaternium 4 (Note c)	-	-	0.6	0.6	
	4. Hydrogen peroxide	2.2	-	2.2	-	
	Sodium bromate	-	10.00	-	10.00	
30	5. Phosphoric acid to about pH 3-4	q.s.	-	q.s.	-	30
	pH value of finished product	3.5	5.6	3.5	6.1	

35 (Note a) The adopted CTFA name for a zwitterion (inner salt) surface active agent corresponding to the Chemical Abstract Service (CAS) Number: 61789-40-0. A preferred material is commercially available under the trademark LONZAIN C supplied by Lonza, Inc., Fairlawn, N.J.

(Note b) The adopted CTFA name for a homopolymer of diallyldimethylammonium chloride corresponding to CAS Numbers 26062-79-3; and 28301-34-0. A preferred material is commercially available under the trademark MERQUAT 100 supplied by the Merck Chemical Division of Merck & Company, Inc.

40 (Note c) The adopted CTFA name for a copolymer of hydroxyethylcellulose and diallyldimethylammonium chloride, commercially available under the trademark CELQUAT L-200 supplied by the National Starch & Chemical Corporation.

45 Compositions A-D remained physically homogeneous on storage at ambient room temperature conditions for a period of at least six months.

The foam generating properties of the neutralizer compositions were examined by the following predictive method:

Deionized water in an amount of 150 milliliters (ml) was placed in a 500 ml graduated glass cylinder. The temperature of the water was about 35 to about 38 degrees C (about 95 to about 100 degrees F). Composition A was added to the water in the cylinder in an amount of 0.5 grams and the cylinder was stoppered. The stoppered cylinder was alternately inverted and uprighted ten times over a period of about 10 to about 15 seconds to produce a column of foam therein. The height of the column of foam was measured in terms of volume as milliliters (ml) immediately thereafter. This procedure was also followed for Composition B, C, and D.

55 The level of foam produced was as follows.

Neutralizer Composition	Volume of Foam (ml)
A	65
B	50
C	55
D	60

The amount of surface active agent in the cylinder represents an active amount of about 0.002 weight percent, and the results were judged predictive of a relatively low level of about 0.1 to about 4 weight percent of the surface active agent would foam on the hair in actual practice during the neutralizing step. A high level of foam observed on the hair in actual practice corresponded to a volume of foam of about 40 to about 50 ml as the lower limit.

The results showed that the relatively low level of surface active agent in Compositions A through D produced a surprisingly high level of foam and the foaming level of ingredient No. 2 was not suppressed by the presence of the cationic polymer, ingredient No. 3. By way of comparison, an aqueous solution containing 0.6 weight percent of ingredient No. 2 at a pH value of about 3.5 produced about a volume of about 50 ml.

#### Example 2. Neutralizer and Conditioner Compositions.

The preparation of Composition A of Example 1 was followed, except that the quaternary nitrogen-containing polymer was polyquaternium-10. Polyquaternium-10 is the CTFA adopted name for a polymeric quaternary ammonium salt reaction product of hydroxyethylcellulose reacted with a trimethylammonium substituted epoxide. This material corresponds to CAS Numbers 53568-66-4; 54351-50-7; 553-19-0 and is disclosed in U.S. Patent No. 3,472,840.

For this Example, the commercially available material designated POLYMER JR-30M was used, supplied by Union Carbide Corporation, Danbury, CT.

The composition prepared was homogeneous and storage stable under ambient room conditions for a period of at least six months. The volume of foam produced by this composition, examined by the method of Example 1, was in the range of about 50 ml.

Substantially similar results were obtained when this composition was prepared with a similar amount of POLYMER JR 125.

#### Example 3. Neutralizer and conditioner compositions.

The neutralizer compositions of this Example illustrate the usefulness of a sultaine that is substantially zwitterionic at all pH values (Composition E) and the usefulness of an anionic surface active agent that is substantially stable to hydrolysis at acid pH values and compatible with cationic ingredients (Composition F).

Compositions E and F were prepared following the procedure of Composition C of Example 1, except for the surface active agent present as shown below.

Ingredient Formula:	Weight percent active	
	E	F
1. Water, deionized, to 100 percent	q.s.	q.s.
2. Cocamidopropyl-hydroxysultaine (Note d)	0.7	-
Sodium C14-C16 olefin sulfonate (Note e)	-	0.7
e. Polyquaternium-4 (Note c, Example 1)	0.6	0.6
4. Hydrogen peroxide	2.2	2.2
5. Phosphoric acid to about pH 3-4	q.s.	q.s.
pH value of finished product	3.5	3.5

(Note d) The adopted CTFA name for a zwitterion (inner salt) that corresponds to CAS Number: 68139-30-0, commercially available under the trademark VARION® CAS supplied by the Sherex Chemical Company Inc., a subsidiary of Schering A.G., Dublin, Ohio.

(Note e) The adopted CTFA name for a mixture of long-chain sulfonate salts prepared by the sulfonation of C14-16 alpha olefins consisting chiefly of sodium alkene sulfonates and sodium hydroxy alkane sulfonates that correspond to CAS Number: 68439-57-6, commercially available under the trademark, Bio Terg AS-40, from the Stepan Company, Northfield, IL.

Compositions E and F were substantially homogeneous and storage stable on standing at ambient room temperature conditions over a period of at least six months. The compositions produced a high foam level of 65 ml and 60 ml, respectively, when examined foam volume was examined by the method in Example 1.

*Example 4. Neutralizer and conditioner compositions.*

This Example compares and illustrates the use of monomeric quaternary ammonium compounds in place of the cationic polymer in neutralizer and conditioner compositions of this invention.

Compositions G, I, J, below were prepared following the procedure for Composition A of Example 1, except for the cationic ingredient No. 3, and Composition H was prepared following the procedure for Composition B of Example 1, except for Ingredient No. 3.

		Weight Percent Active					
10	Ingredient	Formula:	G	H	I	J	10
	1. Water, deionized to 100 percent		q.s.	q.s.	q.s.	q.s.	
	2. Cocamidopropyl betaine (Note a, Example 1)		0.6	0.6	0.6	0.6	
15	3. Cetrimonium chloride (Note f)		0.6	0.6	-	-	15
	Quaternium 33 (Note g)		-	-	1.5	-	
	Dicetyldimonium chloride (Note h)		-	-	-	1.1	
20	4. Hydrogen Peroxide		2.2	-	2.2	2.2	20
	Sodium bromate		-	10.0	-	-	
	5. Phosphoric acid to pH 3-4		q.s.	-	q.s.	q.s.	
25	pH value of finished product		3.5	5.2	3.4	3.5	25

(Note f) The adopted CTFA name for cetyltrimethylammonium chloride, CAS Number 112-02-7, commercially available under the trademark Barquat CT 429 supplied by Lonza, Inc., Fairlawn, NJ.

(Note g) The adopted CTFA name for a quaternary ammonium salt of a lanolin fatty acid supplied under the trademark Lanoquat 1756 by Emery Industries, Inc. Personal Care Products Group, Linden, NJ.

(Note h) The adopted CTFA name for N-hexadecyl-N-dimethyl-1-hexadecanaminium chloride, corresponding to CAS Number 1812-53-9, supplied under the trademark Adogen 432 ET by the Sherex Chemical Company, Inc., a subsidiary of Schering A.G., Dublin, OH.

The results showed that cetrimonium chloride, Ingredient No. 3 in (G) and (H) did not suppress the foaming produced by Ingredient No. 2, and a high level of foam of about 90 ml was produced by the foaming method of Example 1. However, this ingredient was not compatible with the hydrogen peroxide and/or the surface active agent in composition G, forming a precipitate therein on storage at ambient room temperatures within a period of 24 hours, whereas it was substantially compatible with sodium bromate in composition H.

Quaternium 33, the cationic ingredient #3 in composition (I) was also found to be incompatible with the hydrogen peroxide and/or the surface active agent, and formed a precipitate on storage at ambient room temperatures within a period of 24 hours.

Dicetyldimonium chloride, the cationic ingredient No. 3 in composition (J), suppressed the foaming of Ingredient No. 2, producing a volume of foam of about 20 ml by the foaming method of Example 1 and was, therefore, not useful herein.

This Example further illustrates that a di-fatty alkylquaternary ammonium compound may inhibit the foaming function of the zwitterionic surface active agent in a neutralizer of this invention, whereas a mono-fatty alkyl cationic quaternary ammonium compounds may not. However, monomeric cationic quaternary ammonium conditioners do not produce a lasting conditioning benefit on the hair and are, therefore, not used to provide the conditioning function of a cationic ingredient, in the multifunctional neutralizers of this invention.

*Example 5. Storage-stability of neutralizer and conditioner compositions.*

This Example illustrates the storage stability of neutralizer compositions of this invention with regard to the oxidizing strength of the oxidizing agent. The strength of the oxidizing agent was analytically determined by the following predictive accelerated ageing procedure.

The weight percent concentration of the oxidizing agent (hydrogen peroxide or sodium bromate) present in a freshly opened bottle of neutralizer composition packaged in a plastic bottle was determined by standard analytical titrimetric procedures well-known in the art as described hereinbefore. The contents of the same bottle of neutralizer composition, after sampling for analysis, were transferred to a 100 ml volumetric flask up to the 100 ml mark. The neck opening of this flask was loosely covered with foil; and the thus covered flask with its 100 ml contents was immersed up to its graduated neck markings, in a water bath set at a constant temperature of about 80 degrees C (about 176 degrees F) and "aged" for a

period of 24 hours. The flask was cooled to ambient room temperature and the volume of the contents was adjusted with distilled water to the 100 ml mark, if necessary. The concentration of the oxidizing agent in the aged neutralizer composition was again determined. The storage stability of the oxidizing agent was calculated as weight percent oxidizing agent remaining from the difference in oxidizing strength before and after aging.

The storage stability of neutralizer compositions of this invention was as follows.

10	Neutralizer	Weight Percent Oxidizing Agent			10
	Composition	Before Aging	After Aging	Remaining	
15	A of Example 1	2.1454	2.1018	98.0	15
	B of Example 1	10.0468	9.9339	98.9	
	C of Example 1	2.3468	2.3476	100.0	
	E of Example 3	2.0733	2.0179	97.3	
	F of Example 3	2.2453	2.2211	98.9	
	G of Example 4	9.8214	9.9339	99.2	
20	For Comparison				20
	Hydrogen peroxide (Note i)	2.3619	2.3543	99.7	
25	Sodium bromate (Note j)	9.9803	9.9544	99.7	25

(Note i) Hydrogen peroxide in water at 2.3 weight percent, adjusted to pH value 3.6 with phosphoric acid containing no surface active agent or cationic conditioner.

(Note j) Sodium bromate in water at pH value 6.5 containing no surface active agent or cationic conditioner.

The above data show that the neutralizer and conditioner compositions of this invention were substantially storage stable with regard to the oxygen strength of the oxidizing agent of at least 97 percent.

### 35 Example 6. Permanent Waving with Neutralizer and Conditioner Compositions

This Example is an illustration of the usefulness of a neutralizer and conditioner composition of this invention containing a cationic polymer containing a plurality of quaternary nitrogen atoms (Composition A of Example 1) in comparison to a commercial neutralizer composition containing a conventional monomeric quaternary ammonium compound as the cationic conditioner, and no surface active agent (Composition Z).

Six female subjects having normal or tinted hair were given hair waving treatments using a comparative half-head procedure as follows. The entire head of hair was first cleaned by washing it with conventional shampoo in the usual manner. The shampooed hair was towel blotted to a substantially damp state and the left and right portions of the head were sectioned.

The damp hair was longitudinally strained by concentrically wrapping individual locks of hair (hereafter curls) about conventional permanent waving mandrels (hereinafter "curlers"). An alkaline thioglycolate permanent waving lotion, calculated as containing about 7 weight percent of thioglycolic acid in a lotion having a pH value of about 9.2, was applied to each of the wrapped, strained curls and maintained in contact thereon for a period of about 20 minutes.

The waving lotion was removed from the curls by rinsing them with water in the usual manner, and each curl was blotted to a substantially damp state. The curls on one side of the head were neutralized with the Composition A of Example 1 and those on the remaining side were neutralized with Composition Z. Composition B had a pH value of about 3.5 and contained 2.2 weight percent hydrogen peroxide and 1.1 weight percent active dimethylammonium chloride, (Note h of Example 4) as the conditioner with no surface active agent present.

The following neutralizing procedure was followed for each composition.

A first application of a sufficient amount of neutralizer was applied directly to each curl to substantially saturate and wet it. After a period of about 5 minutes had elapsed from the saturation of the last curl, the strain was removed from the hair by removing the curlers.

A second application of the same neutralizer composition used in the first application was applied to an entire half-head portion free of strain in an amount sufficient to uniformly wet all portions of the hair. This applied amount of neutralizer was worked through the hair. The amount of neutralizer composition A of Example 1 applied was sufficient to produce an abundant amount of creamy foam when it was worked through the hair in a shampoo-like lathering motion. The foam was allowed to remain in contact with the hair for a period of about 0.5 to about 2 minutes. No lather was produced on the side where



composition Z was applied. The neutralizer composition was removed from each of the sides by rinsing the treated hair with water.

The hair on the side of the head, that was neutralized with the composition of this invention (A) was substantially free of residual permanent wave odors compared to the opposite side. The hair on side of the head that received the neutralizer composition of this invention (A) had as strong a wave and was conditioned as well as the hair on the side of the head that was neutralized with the commercial product (Z), with respect to easy combing and lubricated feel of the hair.

*Example 7. Permanent Waving with Neutralizer and Conditioner Compositions.*

The procedure of Example 6 was followed, except that the permanent waving lotion used contained glyceryl thioglycolate (calculated as about 12 weight percent of thioglycolic acid) in a lotion having a pH value of about 7.8.

Three female subjects having normal or tinted hair received permanent waves following the neutralization procedure of Example 6. The results were substantially the same as described therein.

*Example 8. Permanent Waving with Neutralizer and Conditioner compositions.*

The procedure of Example 6 was followed, except that the permanent waving lotion contained about 10 weight percent ammonium bisulfite as the reducing agent in a lotion having a pH value of about 7.0.

Eight female subjects having normal or tinted hair received a permanent waves following the neutralization procedure of Example 6. The results were substantially the same as described therein.

*Example 9. Conditioning Benefits of Neutralizer Compositions.*

This Example demonstrates the long-lasting conditioning benefits provided by a neutralizer and conditioner compositions of this invention compared to the temporary conditioning benefits provided by conventional commercial neutralizers.

Six switches of normal, naturally blond hair (DeMeo Brothers, New York) were prepared, each being about 5 inches in length and about 0.2 grams in weight. The procedure of Example 6 was followed, except that the hair switches were not strained, i.e., they were straight waved, and three of the switches were neutralized with each neutralizer.

The lasting benefit of cationic conditioner on the hair was evaluated at three stages: (1) immediately after the neutralization step and drying; (2) after stage 1, followed by one subsequent washing with a commercial detergent shampoo and another drying; and (3) after stage 2, followed by two more washing and drying steps for a total of three shampoos.

The amount of cationic conditioner remaining on the hair switch was determined after each stage by soaking one of the hair switches from each set immediately after stage one in a 0.5 percent aqueous solution of Rubine dye adjusted to pH 3.5 for five minutes at a bath:hair ratio of about 20:1 and then thoroughly rinsing the dyed hair with water. The same procedure was followed with a second hair switch after stage two and with the remaining hair switch after stage 3. The intensity, assessed by a panel of observers, of the Rubine dye color (reddish-pink) remaining on the hair was an indication of the amount of cationic material that was bound to the hair. The results follow.

*Color of hair after rubine dye treatment*

	Neutralizer Composition	After Neutralization	After 1 Shampoo	After 3 Shampoos	
45	Formula A of Example 1	Pink	Pink	Light Pink	45
	Commercial Neutralizer of Example 6	Dark Pink	Faint Pink	Trace of Pink	50

The intensity of the remaining pink color on the hair switches after three shampoos illustrated the long-lasting, substantive conditioning benefits of the cationic polymer present in the neutralizer composition of this invention (A of Example 1). By contrast, the temporary conditioning benefit of the monomeric quaternary ammonium compound present in the commercial neutralizer (Z of Example 6) was substantially removed by one washing with shampoo.

*Example 10. Wave Strength Benefits of Neutralizer and Conditioner Compositions.*

This Example comparatively illustrates the beneficial permanent wave strength produced when a neutralizer conditioner composition of this invention was used.

A series of hair switches were prepared using normal naturally brown hair and tinted hair (DeMeo Brothers, New York) of about 2 grams in weight and about 5 inches in length each. The tinted hair was prepared by tinting normally brown hair with 3 successive dyeings with a commercial oxidation dye product of a blonde hair shade, according to the product instruction, followed by shampooing after each tinting.

The normal hair (N) and tinted hair (T) switches were separately waved, while curler wrapped and stained, using a commercial alkaline waving lotion containing ammonium thioglycolate designated as "Regular" strength and "Mild" strength, respectively. The product directions were followed, except for the neutralization step which was as follows.

- 5 The neutralization procedure of Example 6 was followed, maintaining contact of the neutralizer with the curler wrapped, strained hair for 5 minutes, and then worked through the hair free of applied strain for about one minute. The neutralizer used and post-wave treatment for each series of switches was as follows.

Series 1 - Neutralizer conditioner

- 10 Composition A of Example 1 (pH about 3.5).

Series 2 -Aqueous hydrogen peroxide neutralizer (2.2% by weight, pH about 3.5) containing no surface active agent or cationic polymer.

Series 3 -The hydrogen peroxide neutralizer described for Series 2, followed immediately thereafter with a washing using a conventional commercial shampoo containing anionic surface active agents.

- 15 Series 4 -The hydrogen peroxide neutralizer described for Series 2, followed immediately thereafter with a washing using an aqueous solution of 0.6 weight percent cocamidopropyl betaine (Note a, Example 1) adjusted with phosphoric acid to a pH value of about 3.5).

Immediately following the foregoing neutralization or post-wave treatment, the curl or wave strength was ranked by a panel of five experienced evaluators who were unaware of how each switch had been treated. This same panel of evaluators also ranked the ease of wet combing of each waved hair switch. The average rankings follow.

	Series	Hair Type:	Curl Ranking*		Wet Combing Ranking*	
			Normal	Normal tinted	Normal	Tinted
25						
	1		3.90	3.55	3.50	4.10
30	2		3.30	3.30	2.95	3.20
	3		3.20	3.00	2.90	2.90
	4		3.25	2.85	3.10	2.90

- 35 \* Ranking Scale: 5 - Excellent; 4 - Good; 3 - Fair to Good; 2 - Poor; 1 - Very Poor.

With regard to wave strength, the results of series (1) showed that hair neutralized with a neutralizer conditioner composition of this invention (A of Example 1) produced a surprisingly stronger and uniform curl level than did the oxidizing agent alone in series 2. These results suggest that the oxidizing effectiveness of hydrogen peroxide may be potentiated by the combination of a zwitterionic surface active agent and a polymeric cationic polymer.

The results of Series 3 and Series 4 also showed that washing waved hair, neutralized with aqueous hydrogen peroxide, especially tinted waved hair, tended to decrease in wave strength and combing ease.

- With regard to conditioning benefits as reflected in the wet combing rankings, the neutralizer and conditioner of this invention produced a good to excellent conditioning benefit in series 1.

On the other hand, this same conditioning benefit was not achieved with either aqueous hydrogen peroxide neutralizer in series 2, or with either one of the post-neutralization shampoos in series 3 and 4.

The present invention has been described with respect to preferred embodiments. It will be clear to those skilled in the art that modifications and/or variations of the disclosed compositions and methods

50 can be made without departing from the scope of the invention set forth herein.

## CLAIMS

1. A homogeneous, storage-stable, high-foaming permanent wave neutralizer and conditioner composition comprising water having dispersed therein

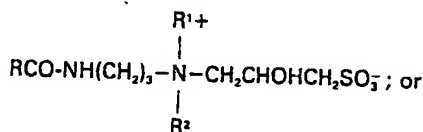
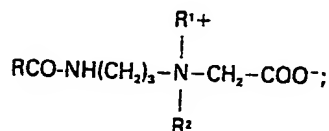
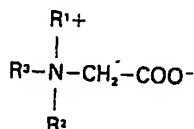
an effective amount of an oxidizing agent useful in the neutralizing step of hair waving processes;

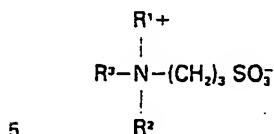
an effective amount of a surface active agent of the group consisting of zwitterionic surface active agents, amphoteric surface active agents and anionic surface active agents, said anionic surface active agents selected from the group consisting of alpha C<sub>14</sub>-C<sub>18</sub> olefin sulfonates, N-fatty acyl sarcosine and alkali metal salts thereof, and N-fatty acyl taurines and alkali metal salts thereof, where the fatty acyl group is derived from C<sub>12</sub>-C<sub>18</sub> fatty acids; and

an effective amount of a water-soluble cationic polymer, said polymer containing a plurality of quaternary nitrogen atoms, and having a molecular weight of from about 500 to about 10,000,000, said composition having a pH value of between about 2.5 to about 8.0,

- 65 the composition capable of producing a high level of foam on contacting human hair during said neu-

- tralizing step and having a storage stability with regard to the oxidizing strength of the oxidizing agent of at least about 90 percent after being heated to a temperature of about 80 degrees C. (about 176 degrees F) for a period of about 24 hours.
2. A composition as claimed in Claim 1 wherein the oxidizing agent is selected from the group consisting of hydrogen peroxide, and alkali metal bromate salts.
3. A composition as claimed in Claim 1 or Claim 2 wherein the surface active agent is selected from the group consisting of agents having a betaine structure, a sultaine structure, an amphocarboxylate or amphoterophosphate structure, an iminodipropionate structure, and an aminopropionate structure.
4. A composition as claimed in Claim 1 or Claim 2 or claim 3 wherein the cationic polymer is selected from the group consisting of
- (a) a polymeric quaternary ammonium salt reaction product of hydroxyethyl cellulose reacted with a trimethylammonium-substituted epoxide;
  - (b) a copolymer of hydroxyethyl cellulose and diallyldimethylammonium chloride;
  - (c) a homopolymer of diallyldimethylammonium chloride;
  - (d) a polymer reaction product of diallyl-dimethylammonium chloride and acrylamide monomers;
  - (e) a quaternary ammonium polymer reaction product of dimethyl sulfate and copolymer of vinyl pyrrolidone and dimethylaminoethyl methacrylate;
  - (f) a copolymer reaction product of acrylamide and methacryloyl-oxyethyltrimethylammonium chloride; and
  - (g) a copolymer reaction product of methylvinylimidazolium chloride and vinyl pyrrolidone.
5. A composition as claimed in any of the preceding claims wherein said pH value is obtained by the presence of an organic acid selected from the group consisting of acetic, adipic, citric and tartaric acids.
6. A composition as claimed in any of Claims 1 to 4 wherein the pH value is obtained by the presence of an inorganic mineral acid selected from the group consisting of boric, hydrochloric, sulfuric and phosphoric acids.
7. A composition as claimed in any of Claims 1 to 4 wherein said pH value is obtained by the presence of an alkali metal hydroxide, selected from the group consisting of potassium hydroxide and sodium hydroxide.
8. A composition as claimed in any of the preceding claims wherein said oxidizing agent is present at about 0.5 to about 15 weight percent of said composition.
9. A composition as claimed in any of the preceding claims wherein said surface active agent is present at about 0.1 to about 4 weight percent of said composition.
10. A composition as claimed in any of the preceding claims wherein said cationic polymer is present at about 0.05 to about 5.0 weight percent of said composition.
11. A composition as claimed in any of the preceding claims wherein the oxidizing agent is hydrogen peroxide present at a concentration of from about 0.5 to about 4.0 weight percent in a composition having a pH value of about 2.5 to about 5.0.
12. A composition as claimed in any of Claims 1 to 10 wherein the oxidizing agent is an alkali metal bromate salt selected from the group consisting of sodium bromate and potassium bromate present at a concentration of from about 5 to about 15 weight percent in a composition having a pH value of about 4.0 to about 8.
13. A composition as claimed in any of the preceding claims wherein the surface active agent is a zwitterionic surface active agent having a betaine or sultaine structure having a general formula selected from the group consisting of:





- where  $R^1$  and  $R^2$  are the same or different and are selected from the group consisting of an alkyl radical having about 1 to 4 carbon atoms and a hydroxyalkyl radical having about 2 to 3 carbon atoms;  
 $R^2$  is an alkyl radical having about 8 to 18 carbon atoms; and  
 $R$  is an alkyl radical having about 7 to 17 carbon atoms.
14. A composition as claimed in Claim 13 wherein  $R^1$  and  $R^2$  are both methyl.
15. A composition as claimed in Claim 13 or Claim 14 where  $R$  and its bonded carboxyl group,  $RCO-$ , of said surface active agent is derived from a  $C_{12}-C_{18}$  fatty acid.
16. A substantially homogeneous, storage-stable, high-foaming permanent wave neutralizer and conditioner composition for use in the neutralizing step of hair waving processes comprising water, about 1.0 to about 3.0 weight percent hydrogen peroxide, about 0.3 to about 2 weight percent of a surface active agent of the group consisting of zwitterionic surface active agents, amphoteric surface active agents and anionic surfactants, said amphoteric surface active agents capable of forming zwitterions within their iso-electric range, said anionic surface active agent selected from the group consisting of alpha  $C_{14}-C_{18}$  olefin sulfonates, N-fatty acyl sarcosine and alkali metal salts thereof, and N-fatty acyl taurines and alkali metal salts thereof, where the fatty acyl group is derived from  $C_{12}-C_{18}$  fatty acids, about 0.2 to about 2 weight percent of a water-soluble, film-forming cationic polymer containing a plurality of quaternary nitrogen atoms, and having a molecular weight of from about 500 to about 10,000,000, said composition having a pH value of about 2.5 to about 4.5, said composition providing a high level of foam on contacting said human hair and being lathered therethrough during the neutralizing step, and having a storage stability with regard to the oxidizing strength of the oxidizing agent of at least about 90 percent after being heated to a temperature of about 80 degrees C (about 176 degrees F) for a period of 24 hours.
17. A substantially homogeneous, storage-stable, high-foaming permanent wave neutralizer and conditioner composition for use in the neutralizing step of hair waving processes comprising water, about 8 to about 12 weight percent sodium bromate, about 0.3 to about 2 weight percent of a surface active agent of the group consisting of zwitterionic surface active agents, amphoteric surface active agents and anionic surfactants, said amphoteric surface active agents capable of forming zwitterions at their iso-electric point, said anionic surface active agent selected from the group consisting of alpha  $C_{14}-C_{18}$  olefin sulfonates, N-fatty  $C_{12}-C_{18}$  acyl sarcosine and alkali metal salts thereof, and N-fatty  $C_{12}-C_{18}$  acyl taurines and alkali metal salts thereof, where the fatty acyl group is derived from  $C_{12}-C_{18}$  fatty acids, 0.2 to about 2 weight percent of a water-soluble, film-forming cationic polymer containing a plurality of quaternary nitrogen atoms, and having a molecular weight of from about 500 to about 10,000,000, said composition having a pH value of about 4.0 to about 8, said composition providing a high level of foam on contacting human hair and being lathered therethrough during said neutralizing step, and having a storage stability with regard to the oxidizing strength of the oxidizing agent of at least about 90 percent after being heated to a temperature of about 80 degrees C. (about 176 degrees F) for a period of 24 hours.
18. A composition as claimed in any of the preceding claims further containing cosmetic adjuvant ingredients selected from the group consisting of preservatives, opacifiers, thickeners, perfumes, auxiliary foam boosting agents, and auxiliary oxidizing agent stabilizers.
19. A homogeneous, storage-stable high foaming permanent wave neutralizer and conditioner composition having one of the following formulae as described in the foregoing Examples:
- A, B, C or D of Example 1.
  - The formula of Example 2.
  - E or F of Example 3.
20. A process for treating hair whose configuration is to be altered including the steps of:
- deforming the normal configuration of said hair by applying longitudinal strain to the hair, said strain physically altering the hair shape into a physically curled or straight configuration while said hair is at least partially damp;
  - contacting the hair while it is so strained with an effective amount of a reductive hair keratin disulfide-bond breaking agent selected from the group consisting of water-soluble thiol and bisulfite ion-containing reducing agents;
  - maintaining said contact for a period of from about 5 minutes to about 60 minutes sufficient for the reductive agent to break hair primary keratin disulfide bonds and form partially reduced strained hair keratin;
  - removing the keratin disulfide bond breaking agent from said partially reduced, strained hair by rinsing with water;
  - blotting the partially reduced, strained hair to a substantially damp state;
  - contacting the blotted hair while it is so partially reduced and strained by applying to said hair a first application of a neutralizer composition as claimed in any of the preceding claims in an amount sufficient to substantially saturate and wet the hair;

- maintaining said contact for a period of about 2 to about 45 minutes to sufficiently realign and reform said broken disulfide bonds into new keratin disulfide bonds to form treated hair;  
 removing said applied strain from said treated hair;  
 contacting said hair while it is free from applied strain by applying to said hair a second application of  
 5 a composition as claimed in any of the preceding claims in an amount sufficient to produce a high level  
 of foam when said composition is lathered therethrough; and  
 maintaining said foam in contact with the treated hair for a period of about zero to about 5 minutes;  
 removing said neutralizer composition from the hair by rinsing said treated hair with water.
21. A process for treating hair whose configuration is to be altered including the steps of:
- 10 deforming the normal configuration of said hair by applying longitudinal strain to the hair, said strain  
 physically altering the hair shape into a physically curled or straight configuration while said hair is at  
 least partially damp;  
 contacting the hair while it is so strained with an effective amount of a hair keratin disulfide bond  
 breaking agent selected from the group consisting of water-soluble thiol and sulfite-ion containing reduc-  
 15 ing agents;  
 maintaining said contact for a period of from about 5 minutes to about 60 minutes to break hair keratin  
 disulfide bonds and form partially reduced hair keratin;  
 removing the keratin disulfide bond breaking agent from said partially reduced, strained hair by rinsing  
 with water;
- 20 blotting the partially reduced, strained hair to a substantially damp state;  
 treating the blotted hair while it is so partially reduced and strained by contacting said hair with a first  
 application of the neutralizer composition of Claim 16 in an amount sufficient to substantially saturate  
 and wet the hair;  
 maintaining said contact for a period of about 2 to about 45 minutes to sufficiently realign and reform  
 25 said broken disulfide bonds;  
 removing said strain from said treated hair;  
 contacting said hair while it is not so strained with a second application of the composition of Claim 16  
 in an amount sufficient to produce a high level of foam when said composition is lathered therethrough;  
 and
- 30 maintaining said foam in contact with the treated hair for a period of about zero to about 5 minutes;  
 removing said neutralizer composition from the hair by rinsing said treated hair with water.
22. A process of waving human hair wherein said hair is treated with a thiol or bisulfite ion-contain-  
 ing waving agent while said hair is under applied longitudinal strain in a curled or straight configuration  
 and said hair is at least partially damp, to break hair disulfide bonds and form partially reduced hair, and  
 35 said broken disulfide bonds are realigned and reformed into new disulfide bonds with a neutralizer com-  
 position containing an oxidizing agent, the composition being as claimed in any of Claims 1 to 19 and  
 being applied to the hair in a first application while the hair is so strained and applied to the hair in a  
 second application while the hair is free of applied strain, said second application being lathered through  
 said hair, the neutralizer then being removed from the hair with water.
- 40 23. A process as claimed in Claim 20 or Claim 21 or Claim 22 wherein the configuration alteration is a  
 permanent wave.